IDIA International Development Informatics Association

Proceedings of the 3rd International IDIA Development Informatics Conference
28-30 October 2009
Berg-en-Dal
Kruger National Park
South Africa
ISBN 978-0-620-45037-9

Wireless technologies and eBusiness infrastructure for Micro and Small Enterprises in rural areas of Kenya: Hype or Opportunity?

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Abstract

The number of mobile telephone subscribers has grown steadily since the liberalization of the Kenyan telecommunications sub-sector through the 1997 Communications Act. This has seen increased wireless technologies penetration in the rural areas. Mobile telephones are the first telecommunications infrastructure in most Kenyan rural enterprises. This has contributed to development through employment creation, access to services and increased access to information. With such a massive acceptance, wireless technologies create opportunities for Micro and Small Enterprises (MSEs) in rural areas to deploy wireless eBusiness infrastructure. Wireless technologies present a unique opportunity for MSEs to overcome their institutional impediments to internet access and e-payments by providing new services and technical capabilities. Wireless technologies offer voice communication, internet access and monetary transactions. Availability of wireless technologies is only an enabling factor. To positively impact organization's performance, wireless technologies must appropriately match organization's eBusiness infrastructure requirements. However, appropriateness alone does not guarantee use. User acceptance is critical to successful implementation of any new technology. This study extends Task-Technology Fit (TTF) theory to incorporate acceptance as a factor that could influence use of Wireless eBusiness infrastructure. The proposed model was empirically tested using questionnaire responses from MSEs in the rural town of Nanyuki. The findings from the study suggest that appropriateness and acceptance do influence the use of wireless technologies to implement eBusiness infrastructure and that using wireless technologies to implement eBusiness infrastructure positively and significantly influences organization's performance. It also found that cost and risk factors have a moderating effect on the use of wireless eBusiness infrastructure. Consequently, the final modified model referred to as the "Suitability of Wireless eBusiness Infrastructure" (***SWeBI***) model has the power to explain use of wireless technologies to implement eBusiness infrastructure and could help practitioners to take efficient measures to improve use of wireless technologies in Kenyan rural MSEs.

Keywords: Wireless Technologies, eBusiness, Task-Technology Fit, Micro and Small Enterprises, user acceptance

1. Introduction

There is no doubt that the explosive growth of cellular networks has an enormous impact on the livelihood of many Kenyans. Mobile phone represents the first telecommunications infrastructure in most Kenyan rural homes and enterprises. Statistics show that mobile network coverage is predominantly urban with data from Communications Commission of Kenya (CCK, 2008) indicating that cellular networks have a national coverage of about 77% of the population (25 million people) and only about 27% of geographic coverage. This may require government intervention in expansion of the cellular networks to underserved areas which are usually regarded as not commercially profitable by service providers. Cellular networks offer voice communication, internet access and monetary transactions. These value added services such as mobile payments, mobile banking, internet access and data access bring developmental benefits to the rural community by improving the way business is conducted and creating business opportunities. Mobile telephones and related services have created new livelihoods through creation of professional and none professional jobs. The availability of cellular networks in rural areas presents a unique opportunity for the Micro and Small Enterprises (MSEs) to overcome their institutional impediments to internet access and e-payments. Cellular networks avail to MSEs banking services (m-banking), payments for goods and services (m-commerce), faster and cheaper communication, as well as internet and data access. The suitability of wireless technologies to meet eBusiness infrastructure requirements for MSEs in rural Kenya is crucial for the uptake of eBusiness applications in MSEs. However, suitability alone does not guarantee technology usage. Technology acceptance by individuals is critical to any successful implementation and use of any new information technology. Most of the Kenyan population lives in the rural and remote areas. Only a small fraction of those living in the rural areas had access to telephone before the cellular network coverage was expanded there. Today, most rural areas have mobile telephone networks which come with a number of developmental benefits in terms of employment creation, access to services and increased access to information contributing significantly to economic growth. The motivation for this research is drawn from a look at the significant benefits mobile telephones have brought to disparate and geographically remote population in Kenya and seek to explore how this expanding mobile phone infrastructure can be harnessed to support enterprise-wide eBusiness infrastructure and benefit MSEs by facilitating use of eBusiness applications. The aim of this study is to determine how appropriate wireless technologies are, for implementing an eBusiness infrastructure in MSEs

by evaluating whether the wireless technologies meets MSEs' eBusiness infrastructure requirements. The following research questions guided the study:

1. Does the extended Task-Technology Fit influence utilisation of wireless technology in implementing an eBusiness infrastructure?
2. Does utilisation of wireless technology in implementing an eBusiness infrastructure result to higher MSE performance?
3. What are the drivers and barriers to utilising wireless technologies to implement an eBusiness infrastructure in Kenyan MSEs?

2. Literature Review

The literature review covers three components of this study. The first section presents the scope of wireless technologies in the study and a review of the direction research in wireless technologies and MSEs has taken over the last few years. The second section presents a discussion on the theory of Task Technology Fit (TTF) proposed by Goodhue and Thompson (1995) while the final section gives an overview of Kenyan MSEs.

2.1 Wireless technologies

Wireless technologies provide ubiquitous access to internet, monetary transactions and enterprise data through cost-effective solutions using mobile devices and wireless networks. Mobile telephones, smart telephones, Personal Digital Assistants (PDA) and wireless modems are part of the many mobile devices that are in use today while wireless networks include the Personal Area Network (PAN) such as use of Bluetooth, Wireless Local Area Networks (WLAN) such as Wi-Fi and Wireless Metropolitan Area Networks (WMAN) such as WiMAX.

Mobile telephones are mostly used for voice communications, short message services and personal information management using calendars, reminders, scheduling. The capacity to offer additional advanced services such as money transfers, accessing bank accounts, and paying bills, receiving special promotions and stock quotes, internet access as well as initiating purchase or sales transactions has increased the level of mobile telephone usage over the last few years. M-Payment is the transfer of money using mobile devices such as a mobile telephone to make payments for good and services. In Kenya today, the services of mobile payments are offered through Safaricom's (http://www.Safaricom.co.ke) Mpesa services and Zain's (htpp://www.zain.co.ke) Zap services.

WLAN allows users to transmit and receive data within a range of 30-50 meters at a rate of up to 54Mbps. Most organizations are adopting WLAN due to its flexibility, convenience and increased reliability. With the absence of cables, there is increased mobility, reduced installation time and cost savings when performing installation in difficult-to-wire areas. Bluetooth is also used to connect devices autonomously in a relatively small area within a radius of ten meters within personal workspaces. WLAN and Bluetooth allow enterprise information to be quickly accessed and transmitted within the enterprises hence increased productivity. WMANs provide mobile broadband wireless access network that meets the needs of business within a metropolitan. Worldwide Interoperability for Microwave Access (WiMAX) technology provides ubiquitous computing with broadband access within a metropolitan for wireless data, voice and video services. WiMAX allows delivery of voice, video and data services to mobile devices hence supporting full user mobility within a metropolitan. Wireless internet is accessed through mobile devices such as telephones and Personal Digital Assistant (PDA), public hotspots and desktop systems connected to a wireless internet access device such as a fixed wireless desktop telephone or a wireless data modem.

Statistics given by International Telecommunication Union (ITU, 2007) regarding access to ICTs indicates that Africa has the least broadband subscriber base with only one million broadband subscribers. This is a meagre 0.4 percent of the 281 million subscribers in the world by the end of 2006. In 2007, Africa had 265 Million mobile telephone users and more than 50 million internet users. Cheaper infrastructure and vast regional penetration, cheaper handsets, competitive markets and business models oriented to the needs of the poorer segments of the population, such as affordable prepaid cards, have resulted in a mobile boom in Africa during the last decade (ITU, 2007). Data from Communications Commission of Kenya (CCK, 2008) indicate that mobile telephone networks have a national coverage of about 77% of the population. This represents more than 25 million people in the country. However, the 27% geographic coverage implies that many parts of the country are not covered especially in the arid and semi arid areas (CCK, 2008). CCK also estimates internet usage at 5% of the population. But now, with high cellular network penetration internet access could increase dramatically in Kenya.

2.2 Task-Technology Fit

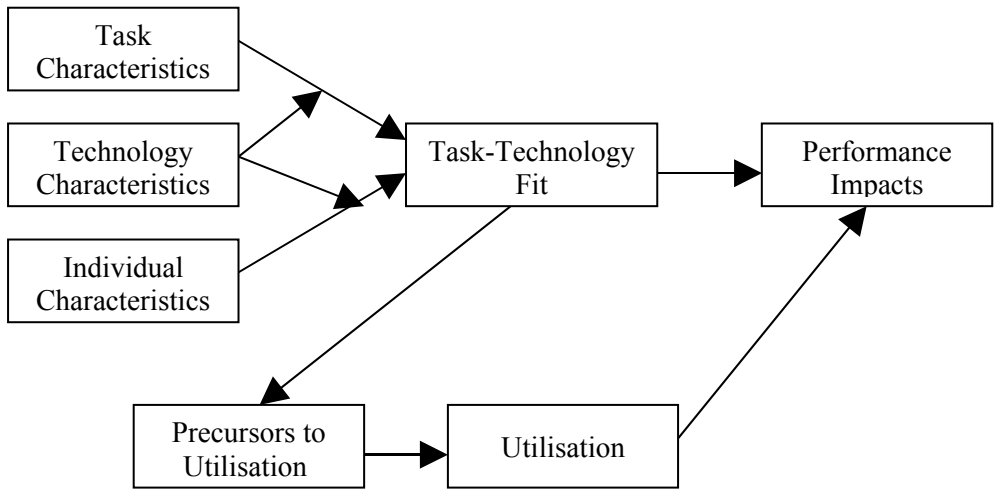
As with any choice and implementation of technology, the question of choosing the right technology at the right time always arises. The main aim of the Task-Technology Fit model by Goodhue and Thompson (1995) is to match the capabilities of the technology to the demands of the particular task. It is the degree to which features of a technology match the requirements of the task and the abilities of the individuals involved with the task. The TTF theory suggests that information systems will have a positive impact on individual's performance only when their functionality is appropriately matched to user task requirements. TTF model originated from the cognitive fit theory of Vessey (1991). Vessey's (1991) cognitive fit theory is based on the proposition that a cognitive fit between the problem solving aids and the problem solving task can reduce the complexity of the task and improve the problem solving effectiveness. Goodhue and Thompson (1995) specified the TTF construct as consisting of the following variables: data quality, locatability of data, authorization to access data, data compatibility between systems, training and ease of use, production timeliness, systems reliability, and information systems relationship with the user. Goodhue (1995) argued that an information technology systems will be used if (and only if) the functions available to the user support the activities of the user, implying that, a system that does not offer sufficient user support will not be used. The major features of the Task Technology Fit are the concepts of technologies, task, individual, and utilization. Task Technology Fit is the relationship between task requirements, technology functionality, technology experiences and task knowledge (Benford and Hunton, 2000).

Dishaw and Strong (1998) validated the TTF model using software maintenance tools through a study on professional computer programmers working in aerospace, insurance and financial services companies, supporting maintenance of both software and data. The results showed that the tool functionality had a positive significant relationship with TTF while task requirements had a significant negative relationship with TTF and actual use of the tool. They concluded that task requirements together with the fit between the task requirements and the technology functionality drive the usage of information technology. Mathieson and Keil (1998) explored the relationship between task-technology fit and perceived ease of use (the degree to which an individual perceives a system easy to understand and use). They found that perceived ease of use was a function of task-technology fit. Benslimane *et al*. (2002) validated TTF on web-based procurement from corporate buyers from organisations operating in various industries in Canada. They concluded that a better fit between the tasks

required during the procurement process and Internet websites' functionalities leads to a higher level of web usage, which then leads to an improved performance for users. Gagnon *et al.* (2004) validated TTF and found reasonably good fit between the task and individuals utilizing the administrative support systems in a university setting. Zigurs *et al*. (1999) showed how a poor fit between a Group Support System (GSS) and the group's task affects group performance. Norzaidi and Intan Salwani (2008) carried out a study to test whether TTF predicts Intranet usage in Malaysia and found that TTF could significantly predict usage if task and technology were fit. Goodhue (1998) argued that the dimension of fit applies to any IT system, including hardware, software and data. The TTF model is also suitable for both mandatory and voluntary use situations and could be extended by introducing new factors. D'Ambra and Wilson (2004) introduced uncertainty factor in the TTF to investigate the adoption of the World Wide Web for international travel. Some researchers usually attempt to integrate TTF with the Technology Acceptance Model (Davis, 1989) by insinuating that the two models complement each other.

This study aims to test the fit between wireless technologies and eBusiness infrastructure within MSEs. To the knowledge of the researcher TTF has not been validated in the context of IT adoption in Kenya and proposes that the model may be suitable for investigating the appropriateness of wireless technologies in implementing an eBusiness infrastructure in Kenyan MSEs. A graphical overview of the TTF model as proposed by Goodhue and Thompson in 1995 is presented below as figure 1.

Figure 1: A graphical overview of the TTF model, (Goodhue and Thompson, 1995).



2.3 Technology Acceptance

The Unified Theory of Acceptance and use of Technology (UTAUT) proposed by Venkatesh, Morris, Davis and Davis (2003) consolidates constructs from eight user acceptance models. Unlike other user acceptance models UTAUT takes into consideration the fact that some systems are mandatory and others are voluntary. UTAUT as formulated by Venkatesh *et al*. (2003) has four constructs. These are Performance Expectancy, Effort Expectancy, Social influence, and Facilitating conditions. These four constructs are the independent variables influencing the dependent variables of behavioral intention and usage. Gender, age, experience with the system and voluntariness of the system have indirect influence on the dependent variables through the four core constructs hence they are moderating factors. UTAUT has an accuracy of 70% in predicting user acceptance of information technology innovations, Venkatesh *et al*. (2003) which all the previous models were not able to successfully do. This is why UTAUT is regarded a superior model. Hence I extend TTF with UTAUT and propose the research model as figure 2.

2.4 MSEs in Kenya

In Kenya, MSEs are defined as those non-primary enterprises (excluding agricultural production, animal husbandry, fishing, hunting, gathering and forestry), whether in the formal or informal sector which employ 1-50 people. Micro-enterprises are those that employ 10 or fewer workers and small enterprises are those that employ 11-50 workers. The business activities of MSEs include manufacturing, trade and service provision. The National Baseline Survey (ICEG, 1999), revealed the existence of 1.3 million MSEs in Kenya by 1999 compared to 910,000 in 1993, reflecting a growth rate of 7% per year. The survey further established that: 66% of the enterprises are located in rural areas; 13.4% of the enterprises are in manufacturing; 64.3% of the enterprises are engaged in trade while 14.8% of the enterprises are in services provision. In 1999, MSEs employed 2.4 million people (ICEG, 1999), while in 2007 MSEs employed 7.5 million people (Republic of Kenya, 2008). The 1999 MSEs Baseline Survey ((ICEG, 1999) shows that the MSEs contributed 18% to GDP, while the Economic Survey of 2003 (Republic of Kenya, 2003) shows that the MSEs contributed 18.4% in the year 2002, implying that, with the help of appropriate technologies and technical support services, MSEs can contribute immensely to the growth of the Kenyan economy.

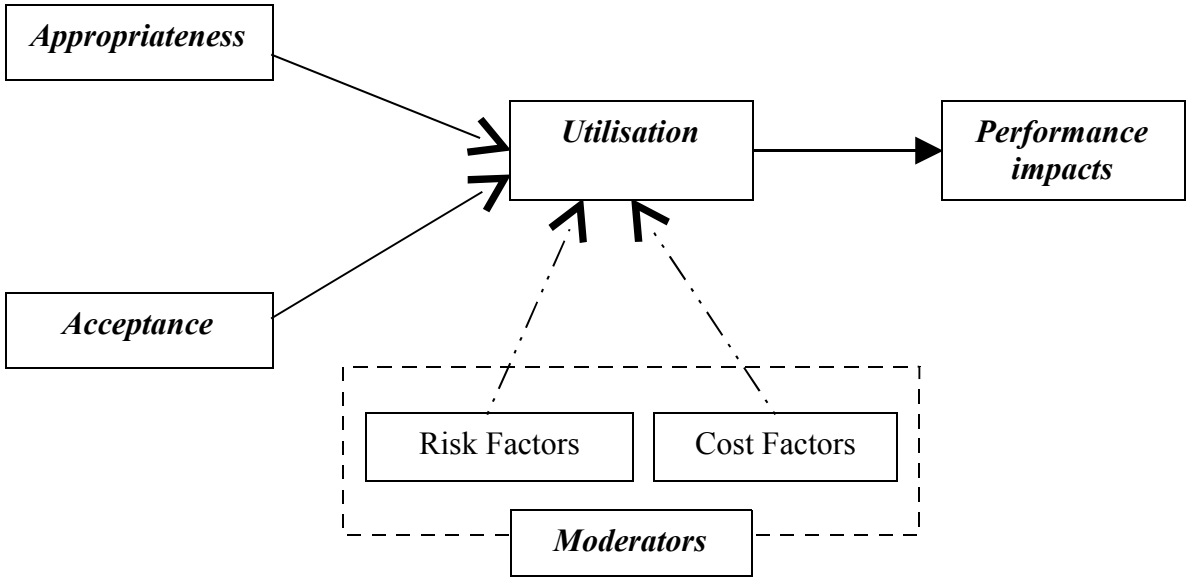
2.5 MSEs and Information and Communications Technology Research

Research on mobile telephone use in MSEs has a study on changes to social and business networks (Donner, 2007). The status of e-commerce in Kenya has been studied by Mureithi (2000), Mulli (2004) and Kiiru (2002). The Kenya country e-preparedness report (Atac, 2003) also highlights ICT access issues between late nineteen ninety's and the year 2003. A further review of published literature on MSEs shows that, to date, a number of studies conducted on MSEs focus on the sector's contribution to the economy in terms of employment, income, and gross domestic product such as the National Baseline Survey (ICEG, 1999). Other studies focus on access to credit (Aketon, 2007), and government policy and strategy frameworks (ACEG, 2006; Ronge *et al*, 2002). Most of the current research focuses on ICT access and usage. There has been no known research, to the knowledge of the researcher, which has studied the use and impact of wireless networks on e-business usage in Kenya. This study seeks to fill this void in research.

3. Methodology

The research model used to guide the study is shown in figure 2. This model is grounded in the streams of research focusing on Task-Technology Fit and Technology Acceptance drawn from literature review to provide a richer understanding of the appropriateness, acceptance utilisation and performance impacts of using wireless technologies in implementing an eBusiness infrastructure in Kenyan rural MSEs.

Figure 2: Research Model: Suitability of Wireless eBusiness Infrastructure *(SWeBI)* Model



This model was designed to incorporate the essential measures to test appropriateness from TTF and measures to test user acceptance from UTAUT as well as moderating variables encountered during preliminary study and which were considered relevant to this study. The measures of Appropriateness were adapted from Task-Technology Fit model by Goodhue and Thompson (1995). The measures for User Acceptance are from Unified Theory of Acceptance and use of Technology (UTAUT) proposed by Venkatesh, Morris, Davis and Davis (2003). Utilisation measures are usage of voice calls, text messages, m-payments, m-banking, data networks, internet access and information management using calendars and reminders. Performance impacts were measured through improved productivity, improved communication and coordination, reduced coordination costs and faster transactions. Each item in the model had a corresponding set of questions. The questionnaire was composed of sixty two questions, unambiguous and easy for respondents to complete. Each item on the questionnaire was measured on a five-point Likert scale with end points of "strongly agree" (5) and "strongly disagree" (1). A list is presented here as table 1.

Table 1: Constructs and their measures

Model Construct (Items)	**Measures**	**Adapted from**
Appropriateness (10)	Quality of data, locatability of data, Ease of use, Training, Timeliness, System reliability, Relationship with users	TTF (Goodhue and Thompson, 1995)
	Mobility: employees can access same services from any where	Author's preliminary study
Acceptance (7)	Perceived usefulness, Social influence (Business Environment)	UTAUT (Venkatess *et al.*, 2003)
Moderators (7)	Risk factors, Cost factors (Affordable prices) of using wireless eBusiness infrastructure	Author's preliminary study
Utilization (4)	Use and frequency of using wireless technologies	TTF (Goodhue and Thompson, 1995)
Performance impacts (4)	Improved productivity and efficiency, reduced operation costs, improved communication and coordination, improve effectiveness	TTF (Goodhue and Thompson, 1995)

To test the research model, a survey was conducted using a questionnaire to gather the necessary information from Nanyuki town. Nanyuki town was purposely selected for this study because it has all the characteristics of a Kenyan rural town. Nanyuki is a town lying on

the equator and North West of Mount Kenya. It is often visited by climbers and backpackers on their way to or from Mount Kenya. Mount Kenya is the highest mountain in Kenya and the second-highest in Africa (after Mount Kilimanjaro). Economic activities in the Nanyuki consist mainly of tourism, trade and agriculture (particularly in the horticulture and ranching). Other economic activities include small scale industries in textile and food processing.

4. Analysis and Results

MSEs in Kenya operate under similar conditions and have uniform characteristics. This makes the sample size to be used not a critical factor. The questionnaire was administered to 60 enterprises in Nanyuki town. 54 responses were received. After eliminating incomplete responses, 50 usable responses were selected as the sample. Out of the 60 questionnaires distributed, 50 usable responses were returned representing an overall response rate of 83.33%. Such a good response rate was attributed to the ample response time of ten days given to the respondents to complete the questionnaire and the follow-up telephone calls made to the respondents in order to encourage their participation. Another contributing factor could be that most of the respondents are the owners or the managers of these enterprises.

The survey results were analysed with the statistical application software SPSS 15.0 for Windows® and Microsoft Excel 2003®. Tables in this paper were also constructed with these applications.

The following table gives a demographic breakdown of respondents by gender, age, education, roles of the respondents, years of internet and computer usage, the number of wireless technologies in use and the number of eBusiness applications in use.

Table 2: Demographic characteristics of the participants

Overview of respondents		**Frequency**	**Percentage**
Gender	Male	32	69.57

	Female	14	30.43
Age	18-24	14	30.43
	25-34	20	43.48
	35-44	6	13.04
	45-54	6	13.04
Education Level	High School	2	4.35
	Diploma	12	26.09
	Professional Course such as CPA	6	13.04
	College certificate	8	17.39
	Undergraduate degree	16	34.78
	Postgraduate degree	2	4.35
Role of the respondents	Managers	36	72
	Computer systems support staff	8	16
	Sales	2	4
	Accountants	4	8
Enterprises which have a website		11	22
Average number of wireless technologies in use			10
Average number of eBusiness applications in use.			3

The average number of wireless technologies and related services in use is 10. Using mobile payments and mobile banking makes it easier to conduct business, and almost all enterprises in the study have used it and the entrepreneurs trust in M-banking and M-payments. The number of enterprises using eBusiness applications is also relatively high, implying that the uptake of eBusiness applications in the rural Kenya is gaining acceptance. This could also be attributed to adequate infrastructure provided by wireless technologies which has proved to be highly beneficial to the enterprises

Internal consistency is used to assess the consistency of results across items within a test. Cronbach's Alpha is the most widely used diagnostic measure of internal consistency. Cronbach's Alpha was calculated for the six core constructs and the results are presented in table 3 below. All the constructs exhibited a Cronbach's alpha above the 0.7 acceptable threshold as reported by Hair *et al.* (1998). The results show that the questionnaire was a reliable measurement instrument.

Table 3: Reliability analysis and Descriptive Statistics*

Construct	Reliability (Cronbachs's α)	Mean**	St. Deviation
Appropriateness	0.924	4.08	0.944
User Acceptance	0.939	3.68	0.741
Utilisation	0.812	4.36	0.563
Costs	0.953	3.62	1.107
Risks	0.895	3.44	1.195

Performance Impacts	0.952	4.24	0.657

*** N=54, ** based on a scale of 1-5**

A correlation analysis was then run based on each of these constructs, and the results reported in table 4. Pearson's correlation was used to assess the internal validity of the constructs and the results indicated a strong positive correlation for all the variables. With the absence of negative Pearson's correlation, no variable was dropped.

Table 4: Correlation Matrix

Variable	Pearson's Correlation
Appropriateness	.655
User Acceptance	.616
Utilisation	.505
Costs	.771
Risks	.595
Performance Impacts	.620

5. Discussion

The primary purpose of this study was to investigate the extent to which wireless technologies meet the eBusiness infrastructure requirements of Kenyan rural MSEs. The outcome of the study highlights that Appropriateness and user acceptance directly influences utilization of wireless eBusiness infrastructure while ultilization have a huge positive impact on performance of MSEs in rural areas. Wireless technologies consist of data networks, cellular internet and mobile payments. This provides the necessary infrastructure for eBusiness applications usage by allowing internet access, local area networks, remote data access and e-payments. The potential of wireless technologies to facilitate internal business process automation, procurement and supply chain management, marketing and sales processes management and e-commerce and customer relationship management, all which require faster access to current information, is significant. The cost of using and maintaining the systems seems to be a key aspect of choosing to use wireless technologies to implement eBusiness infrastructure. The entrepreneurs also consider after sales support as a major factor affecting the decision to continue using a particular vender's service. When a new provider emerges and offers the same services at a better price, greater quality coupled with efficient support and a faster response to down time, this provider wins over all the existing users. The entrepreneurs seem to be using the word of mouth to share their experiences in using a particular wireless technology and eventually influencing other users' decision to use the

technology. Another major issue that seems to determine the use of wireless technology is access to information. There is lack of awareness on all the benefits of using wireless technology in implementing eBusiness infrastructure in some MSEs. Most entrepreneurs depend on corporate marketers to get information about the available wireless technology services. This leads to use of technology on bases of first (sales person) come first served or on who is convincing well enough. These marketers do not necessarily assess the technological and organisational issues necessary in acceptance and usage of their products before recommending the application of a particular technology. Their main catch is on costs and not the quality of their services as they are familiar with the limited budget and resource allocation for information technology related investments within MSEs. This creates a need to have the government subsidise infrastructure roll-out in areas regarded as not being commercially profitable by most service providers. Some MSEs considered cost of installation and daily usage to moderate their use of wireless technologies while security and privacy risks were considered a high priority while using wireless technologies.

6. Conclusion

The findings of the study demonstrate the suitability of wireless technologies to implement eBusiness infrastructure in Kenyan Rural MSEs. MSEs in Kenyan rural areas are today using wireless technologies to implement eBusiness infrastructure leading to the existence of Smart MSEs. Smart MSEs manage their customer relationships, supply chains and core business operations using wireless technologies, making them more efficient, enhancing their productivity and improving on their internal and external communications. Efficiency due to mobility, reduced installation cost and time, increase in employee's productivity and customer satisfaction are some of the benefits MSEs are enjoying as a result of implementing eBusiness using wireless technologies. Also reduced connection costs, ease of installation and maintenance make wireless technologies an ideal choice in implementing eBusiness infrastructure for most rural MSEs. All these benefits have a positive direct effect on MSEs' profitability and performance. Using the research model developed in this study, the entrepreneurs can test any technology availed to them and decide on what bases to use the technology or not and establish which technology is suitable to be the enterprise's IT infrastructure. Wireless technologies faithful usage increases user's task performance when the technologies fit the required tasks and the user is sufficiently competent to use the technology.

Wireless eBusiness infrastructure has increased competitiveness in most MSEs as they seek to improve how they operate in terms of quality of service, faster and cheaper transactions and efficiency. Wireless technologies have proved to be highly beneficial and have led to better organisational performance, hence they are not just hype but an opportunity for Kenyan rural MSEs to implement their eBusiness infrastructure.

Limitations and further research

Relatively limited geographic area: This study highlights the use of extended Task-Technology Fit to evaluate application of wireless technologies to implement eBusiness infrastructure in Kenyan rural MSEs. It is therefore recommended to do further research in use of wireless technologies to implementing eBusiness infrastructure in Kenyan cities and do a cross country comparisons.

Generalization of the results to other sectors or countries: This should be made carefully because only the Kenyan rural MSEs sector was investigated in this study. Further research could also be done to include other sectors within the Kenyan economy for comparisons.

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